METHOD FOR THE ANALYSIS OF A NUTRITIVE PRODUCT

W917

FIELD OF THE INVENTION

This invention relates to a method for the analysis of a nutritive product in a stage of treatment, in respect of a volatile or volatilisable compound present in or derived from said product. The invention concerns also a method for assorting the nutritive products on the basis of the result obtained from the analysis.

BACKGROUND OF THE INVENTION

The food industry encounters a variety of different kinds of unsolved problems involving volatile compounds. Thus there is a common need in various areas of food production for a fast method of analysis of volatile compounds. This need is evident e.g. during raw material breeding, cultivation, growing and selection, but also for process and product quality control, as well as hygiene and shelf life control.

The volatile compounds emitted or released should be analysed, as much as possible, both quantitatively and qualitatively, in their natural state. The information obtained would be useful and beneficial when optimising the safety, nutritive, profitability and sensory properties of the object to be analysed and to achieve a standard-quality raw material, process or product. At any step of the process, from raw material to product, composition of the volatile compounds may correlate with sensory properties of the raw material or product emitting said volatile compounds.

An example of such a problem to be solved within the food industry is the occurrence of boar taint as an off odour of pork. Boar taint is an occasionally existing off odour of pork (pig meat) caused by the presence of 3-methylindole

(skatole), 5-α-androst-16-en-3-one (androstenone) and some other minor compounds.

Skatole is a microbial degradation product of amino acid tryptophan in the intestinal tract of pig. However, only male pigs accumulate indolic compounds, such as skatole, in their adipose tissues. Androstene steroids are, again, synthesized in testes and transported by blood circulation in adipose tissues and salivary glands. Thus, the boar taint precursors may exist in several organs in swine, especially in non-castrated boars.

Non-castrated, intact male pigs have higher fattening properties when compared with castrates and gilts. This is due to the effects of androgens. Boar production is thus an economically feasible approach. One limiting factor is that a small proportion of non-castrated male pigs emit the "boar-taint" off-odour during cooking and frying. Also on ethical reasons castration is less and less accepted in pork production.

The accumulation of skatole and androstenone in carcasses depend on several genetical and environmental factors. Production of androstenone depends on the age (sexual maturity) whereas skatole is mainly related to environmental conditions and dietary aspects.

At present, the assessment of existence of off-odorous compounds in carcasses is carried out by sampling and by analysing the sample in a laboratory. The most common methods applied are based on gas chromatographic (GC), high performance liquid chromatographic (HPLC), supercritical fluid chromatography (SFC), enzyme-linked immunoassay (ELISA) and colorimetric analysis of fat (adipose tissue), salivary glands and blood. All these methods require such an amount of sample preparation that none of them is an on-line method of analysis.

The disadvantages related hereto are the considerable time delay from the sampling until the result of the analysis is available. The analysis results are obtained at a time point when it is too late to use said results for assorting purposes. The analysis

results are thus mainly useful for documentation purposes. At present, there is no on-line method of analysis in use for this purpose.

OBJECTS OF THE INVENTION

The aim of the present invention is to provide a method for the analysis of a nutritive product in a stage of treatment, in respect of a volatile or volatilisable compound present in or derived from said nutritive product, which method is fast enough to make the result of the analysis available to the stage of treatment while the analysed product still is in said stage of treatment.

The aim could e.g. be to provide a method for the fast analysis of off-odour compounds from swine carcass, wherein such compounds can be identified by an on-line analysis e.g. in an abattoir directly from the carcasses on a conveyor, after which the carcasses may be assorted according to their sensory quality. The swine carcasses can be assorted without delay in production in various quality classes, which is an economically profitable approach.

SUMMARY OF THE INVENTION

Thus, according to one aspect this invention concerns a method for the analysis of a nutritive product in a stage of treatment, in respect of a volatile or volatilisable compound present in or derived from said nutritive product, wherein a sample of said nutritive product is taken, optionally prehandled and subjected to analysis. According to this invention, the analysis is carried out by a direct inlet gas-phase Fourier transform infra red (FT-IR) spectroscopic method fast enough to make the result of the analysis available to the stage of treatment while the analysed product still is in said stage of treatment.

According to another aspect, this invention relates to a method for assorting a nutritive product in a stage of treatment, and subsequently directing the product to optimal use. The method is characterized by the steps of

a) identifying pieces of the product,

b) analysing identified pieces of the product in respect of a volatile or volatilisable compound present in or derived from said product, according to the aforementioned analysis methods of this invention,

c) labelling the analysed pieces of the product according to the analysis results, and

d) assorting the product into several classes for different uses.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 shows an FT-IR spectrum of an orange juice sample.

Figure 2 shows an FR-IR spectrum of a sample of coffee.

Figure 3 shows an FT-IR spectrum of a strawberry sample.

Figure 4 shows an FT-IR spectrum of skatole.

DETAILED DESCRIPTION OF THE INVENTION

Definition of terms and general description

The wording "nutritive product" shall be understood to mean any edible product for humans or animals, such as foods, feeds, food raw materials and feed raw materials of any kind. It shall also be understood to mean all products to be incorporated into food products such as food ingredients, food supplements as well as compounds comparable to food products such as nutraceuticals.

"Direct inlet gas-phase FT-IR spectroscopic method" shall be understood to mean a Fourier Transformed infrared spectroscopic method in which the sample gas is or volatiles are injected directly to the spectrometer's sample cell. FT-IR method does not in this context refer to FT-IR coupled with any chromatographic device.

"Stage of treatment" relates to any stage in which the product is handled before it has reached the end consumer or reached a point where no assorting of the product any longer can be carried out. This wording will thus, for example, cover field, transporting system, storages, factories, storehouses, kitchens, and spaces where the nutritive products are handled, processed or stored.

The analysed parameter is a volatile or volatilisable compound present in or derived from the nutritive product. According to this definition, the compound to be detected may be readily volatile, or it may be volatilisable upon certain measures such as suitable heating, gas rinsing or application of reduced pressure, for example. This definition covers also the preparation of a derivative of said compound, where said derivative is readily volatile or volatilisable as mentioned above.

The aim of the analysis is to detect and optionally also quantify volatile compound of the product, or to determine the susceptibility of the product to form volatile compounds, where said volatile compounds are biologically active, odorous, or

indicative, e.g. indicate that a product has been destroyed by micro-organisms, although that no off-odour can be noticed.

The aim of the analysis may be to pick out pieces of products releasing unwanted volatile compounds so that such pieces are prevented from reaching the batch of excellent quality. Instead, such pieces are directed to an appropriate use, or, in the worst case, destroyed.

On the other hand, the aim of the analysis may be to pick out pieces of products releasing highly desirable volatile compounds so that such pieces can be classified as products of particularly good quality.

If the volatile compounds analysed are quantified, then the product can be divided into many classes depending on the concentration of the volatile compound.

The sampling can be carried out manually or automatically.

It is essential that the analysis is carried out by direct inlet gas-phase FT-IR method fast enough to make the result of the analysis available to the stage of treatment while the analysed product still is in said stage of treatment. The acceptable delay from sampling until delivery of analysis results depends on the stage of treatment in question. In a rapid transport conveyor, the delay may be seconds or parts thereof. If the stage of treatment is storage, then the acceptable delay may be much longer. Anyway, it is essential that the result is delivered in sufficiently good time so that the result obtained can be used for decision making, not only for documentation, in said stage of treatment.

The spectrum obtained is preferably compared to reference spectra in a spectral library in a data processing unit.

According to one embodiment, the analysis is carried out to determine one or several predetermined known compounds.

According to an alternative embodiment, the analysis is carried out to determine whether a compound or mixture of compounds, which gives rise to a predetermined spectrum, is present in or derivable from the nutritive product.

The analysis method according to this invention is particularly useful for the investigation of an animal carcass, especially a swine carcass on a conveyor in a slaughterhouse, wherein the carcass is analysed in respect of off-odours, especially skatole and/or androstenone. When the analysis result is available before the carcass has reached a switch point for selection of track, a carcass with too high concentration of the unwanted volatile compound can be prevented from reaching the line for first class swine meat.

Based on the use of the analysis method according to this invention, it is possible to assort a nutritive product in a stage of treatment, and to subsequently direct the product to optimal use. The assorting step can be carried out manually or automatically, depending on the acceptable time delay in the said stage of treatment. The choice of the appropriate use may guided by, for example, safety, nutritional, economical ethical, sensory or other reasons. Pieces of the products are identified (i.e. equipped with an identification number or the like), analysed, labelled according to the result from the analysis, and finally assorted according to the label, into several predetermined classes destined for different uses.

In case the product to be studied and assorted is an animal carcass, e.g. a swine carcass on a conveyor in a slaughterhouse, then each carcass is identified, analysed in respect of off-odours, especially skatole and/or androstenone, labelled and directed on a suitable track at a switch point in the conveyor.

If the product to be studied and assorted is fruit, vegetables, and other products comprising a great amount of pieces, then it may be sufficient to identify, analyse and label just a representative amount of pieces of the product.

The invention is illustrated more in detail by the following non-limiting examples.

Example 1

The slaughtered pigs on a conveyor are individually marked so that they can be identified manually or automatically. A sample of the carcass, e.g. a biopsy of the neck fat, will be taken. The sample is then transferred into one of the Fourier-transform infra red (FT-IR) analysers. The sample is treated in a proper way to introduce the volatile compounds to be analysed into the measuring unit, e.g. heating the sample in a suitable way. The results are handled in a data process unit.

After data processing the final rating information together with the identification code will be sent to the switch point(s) of the conveyor to direct the carcass on the selected track.

Example 2

This example describes a similar analysis and assorting process as that of Example 1, using a low resolution FT-IR analyser GASMET™ combined with CALCMET™ multi-component analysis system to analyse the content of skatole in the biopsy taken from neck fat of the carcass, which sample is heated and the volatiles introduced into the analyser. An FT-IR spectrum of skatole (Fig. 4) measured by GASMET™ is used as the library spectrum for CALCMET™, which spectrum does show impurities, e.g. water and carbon dioxide.

Example 3

FT-IR spectra of nutritive products are typically highly specific as demonstrated by Fig. 1–4. Fig. 1 is a FT-IR spectrum of a sample of orange juice showing absorbance versus wave number. Correspondingly Fig. 2 is a FR-IT spectrum of a sample of coffee and Fig. 3 of strawberry.

Table 1 below further demonstrates that nutritive products can be characterized based on their volatiles. Different varieties of strawberries definitely show a different profile of volatiles.

Table 1 Significance of differences ($p<0.05$) of six different strawberry varieties grown in 1998. Different letters in the columns indicate the statistical differences between strawberry varieties in relative amount of certain volatile compounds determined from the vapour phase of strawberries.

Strawberry variety	Acetone	Ethyl butanote	Ethyl acetate	Ethanol	Methanol	Butane-2,3-dione	Acetaldehyde	Pentan-2-one	Heptan-2-one	*cis*-3-hexenol	Hydroxyfuranone[1]	Methyl butanoate	Methoxyfuranone[2]
Senga	B	B	A	A	A	C	AB	C	B	A	B	A	A
Jonsok	B	C	BC	A	AB	A	B	D	A	A	B	A	A
Korona	A	A	BC	A	AB	B	C	C	B	A	B	A	A
Polka	A	A	CD	A	AB	C	BC	A	B	A	C	A	A
Honeoye	B	A	AB	A	B	D	D	A	C	A	A	A	A
Bounty	A	A	D	A	AB	BC	C	B	B	A	BC	A	A

[1] = 2,5-dimethyl-4-hydroxy-3(2H)-furanone, [2] = 2,5-dimethyl-4-methoxy-3(2H)-furanone

It will be appreciated that the methods of the present invention can be incorporated in the form of a variety of embodiments, only a few of which are disclosed herein. It will be apparent for the specialist in the field that other embodiments exist and do not depart from the spirit of the invention. Thus, the described embodiments are illustrative and should not be construed as restrictive.